The Collider Rings

The RHIC facility is a complex set of accelerators interconnected by beam transfer lines. The injector system can be operated independently of the collider. The main 3.834 km long tunnel is connected to the AGS through the injection tunnels. The collider has support buildings, four completed experimental areas (two additional undeveloped experimental areas also exist), and a cryogenic refrigerator system with the capacity to meet RHIC requirements. The RHIC tunnel is located towards the northwest corner of the Brookhaven site. The site plan in Fig. 1 shows all major components of the RHIC complex.

Bending and focusing of the ion beams is achieved by the ring magnets. In view of the fixed tunnel circumference, a cost optimization lead the choice of relatively low-field superconducting magnets. At a magnetic field of 3.458 T, the beam energy is 100 GeV/n for fully stripped gold ions, and 250 GeV for protons. The required field is generated with single-layer cosine-theta magnets, which, for maximum operational flexibility, are contained in vacuum vessels separate for each ring, except those near the collision points. The collider consists of two rings of superconducting magnets. The main components of the magnet system are 288 arc-size dipoles and 108 insertion dipoles, and 276 arc and 216 insertion quadrupoles. In addition to dipoles and quadrupoles, there is an inventory of smaller magnets consisting of 72 trim quadrupoles, 288 sextupoles and 492 corrector magnets at each quadrupole. For polarized proton spin manipulations there are 24 superconducting helical magnets in each ring, grouped into 2 snakes and 4 spin rotators. The arc dipoles have a physical length of 9.728 m (9.45 m effective), are bent with a 4.85 cm sagitta and have a coil aperture of 8 cm in order to accommodate the requirements due to intrabeam scattering. The cold bore beam tube aperture is 69 mm in diameter. The beams in the arcs are 90 cm apart.

The magnets are cooled to a temperature of <4.6 K by circulating supercritical helium, which is supplied by a 24.8 kW refrigerator. The various ring magnets are excited by an appropriate power supply system and protected by a quench protection system. The beam tube in the superconducting magnets is at the temperature of liquid helium. An extremely good vacuum with an equivalent warm pressure $<10^{-11}$ Torr is obtained, in the absence of leaks into the cold bore. In order to avoid the formation of electron clouds, beam loss and radiation background, a vacuum of about 7×10^{-11} Torr is required in the warm beam tube sections of the insertion regions. The cryostats for the superconducting magnets require a separate insulating vacuum of less than 10^{-5} Torr in order to avoid a heat load due to convection.

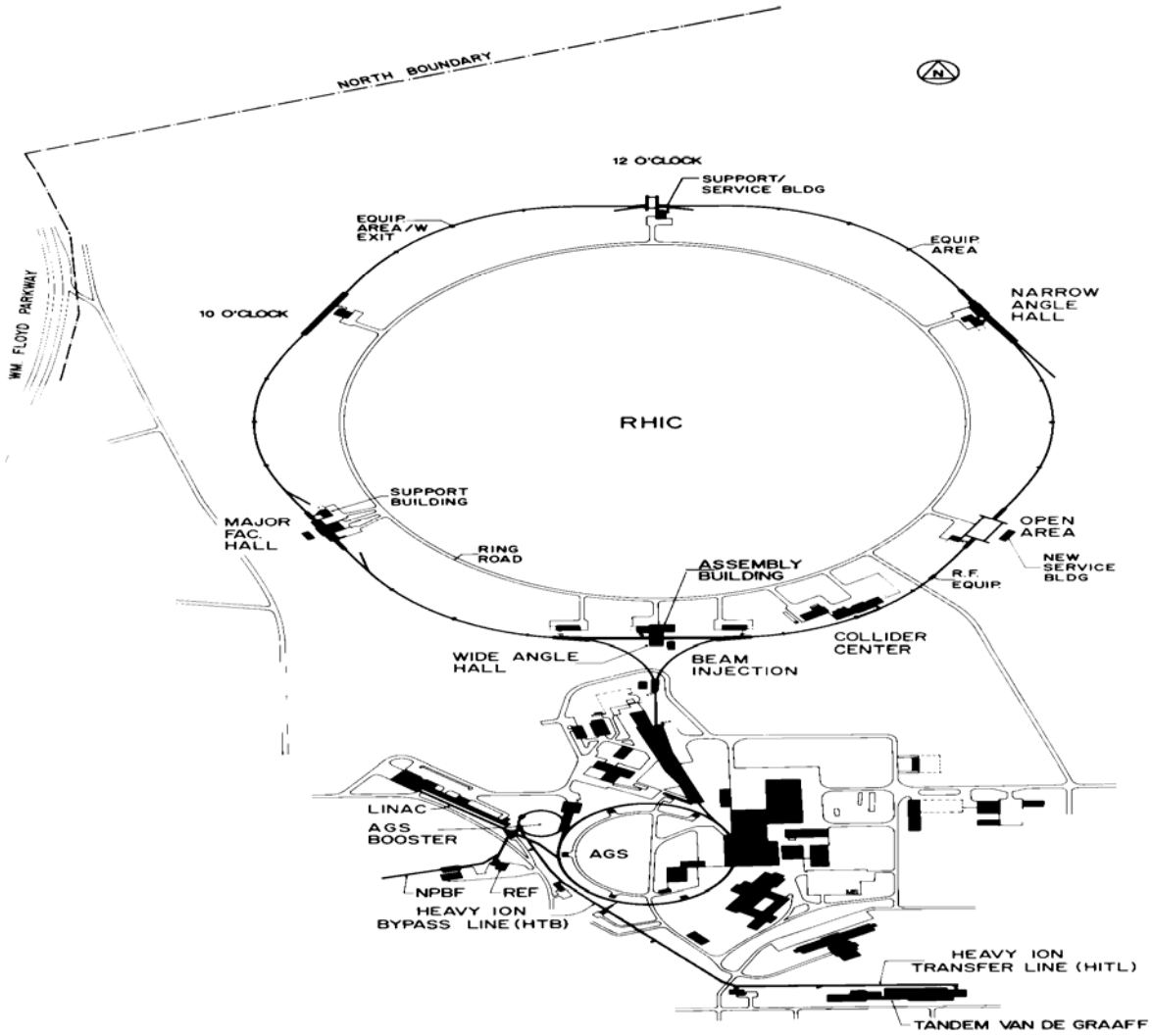

Fig. 1. Layout of RHIC facility – injectors and collider.